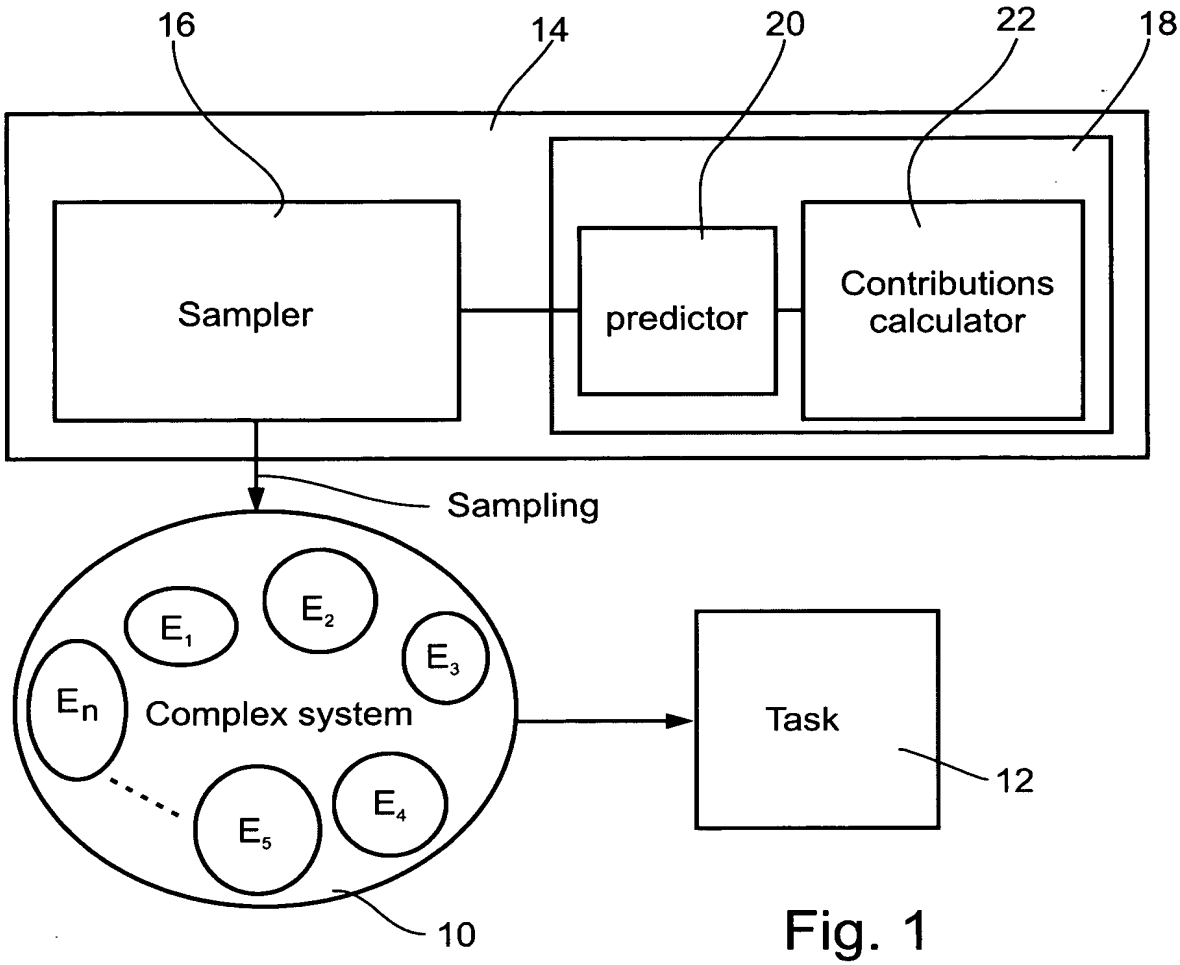
16
14
20
22
18
Sampler
predictor
Contributions calculator
Sampling
E1
E2
E3
En
Complex system
E5
E4
10
Task
12

Fig. 1

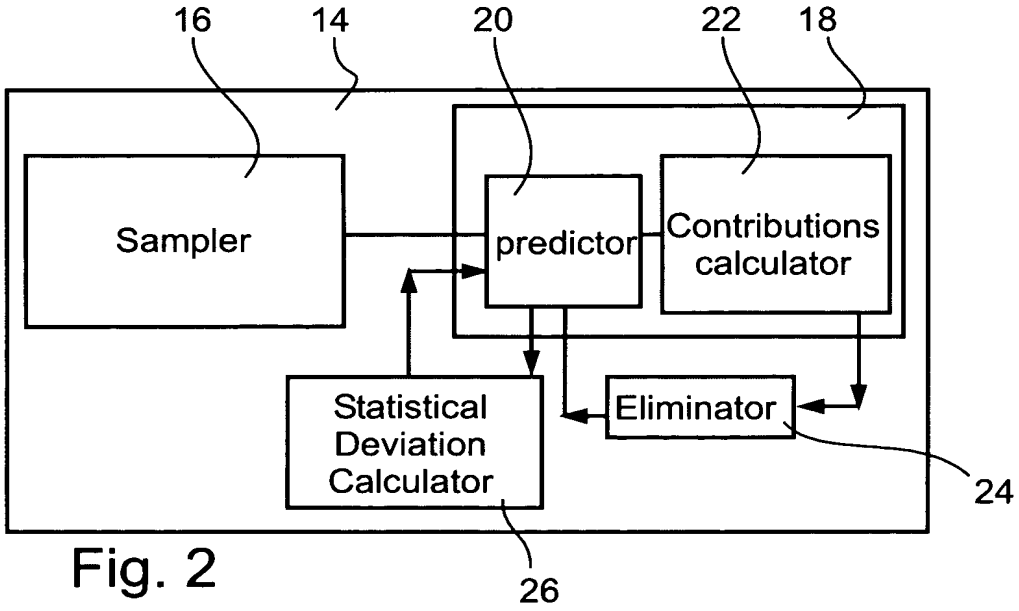
16
14
20
22
18
Sampler
predictor
Contributions calculator
Statistical Deviation Calculator
Eliminator
24
26

Fig. 2

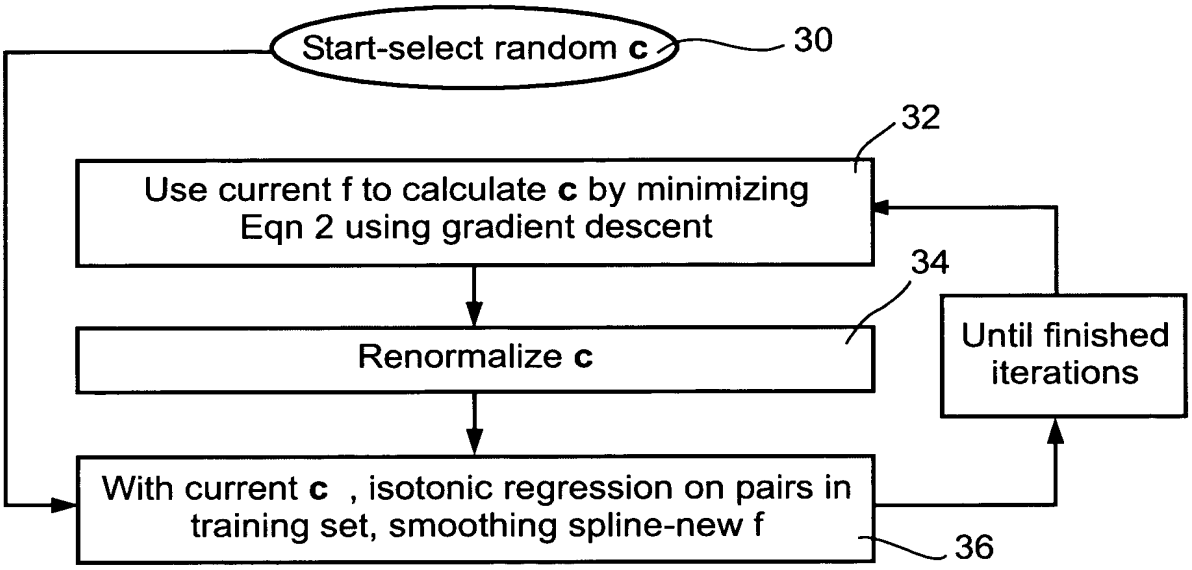

Fig. 3 Prior Art

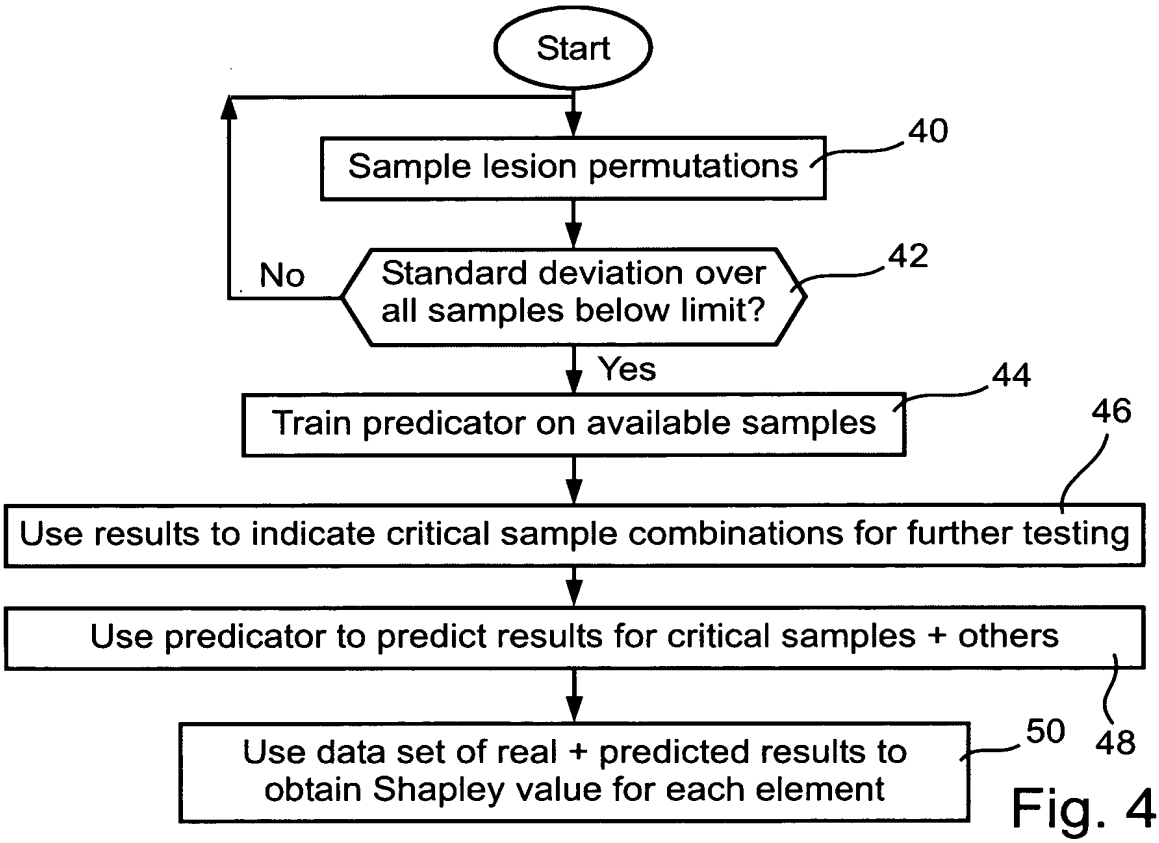

Fig. 4

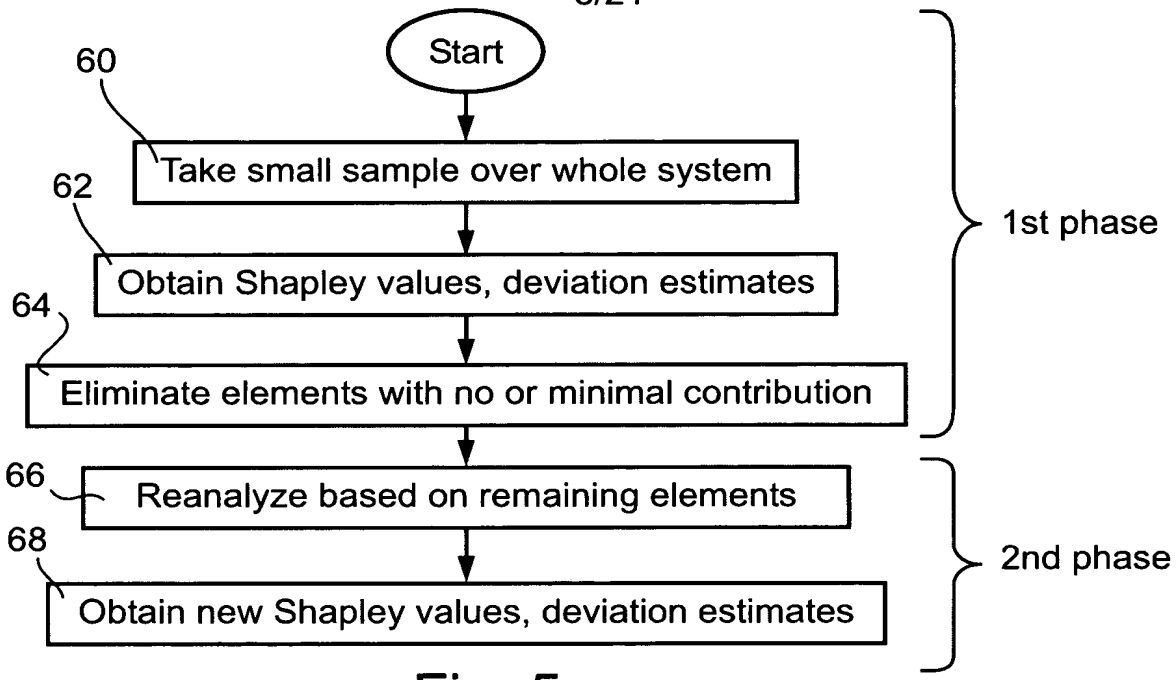

Fig. 5

Fig. 6

Fig. 7

Fig. 8

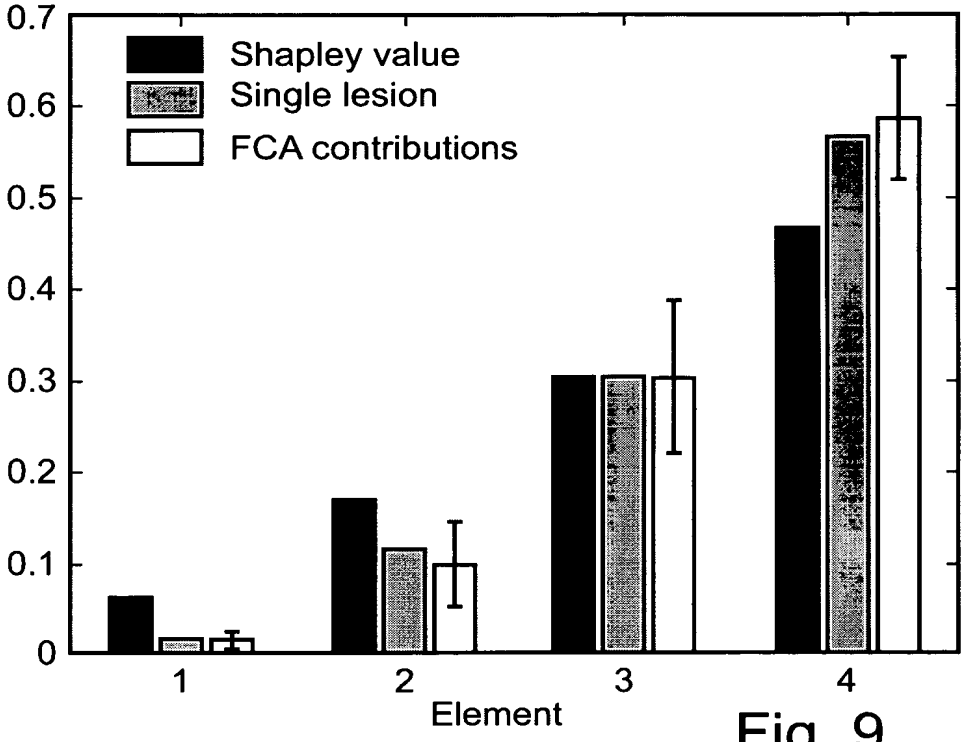
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
Shapley value
Single lesion
FCA contributions
1
2
3
4
Element

Fig. 9

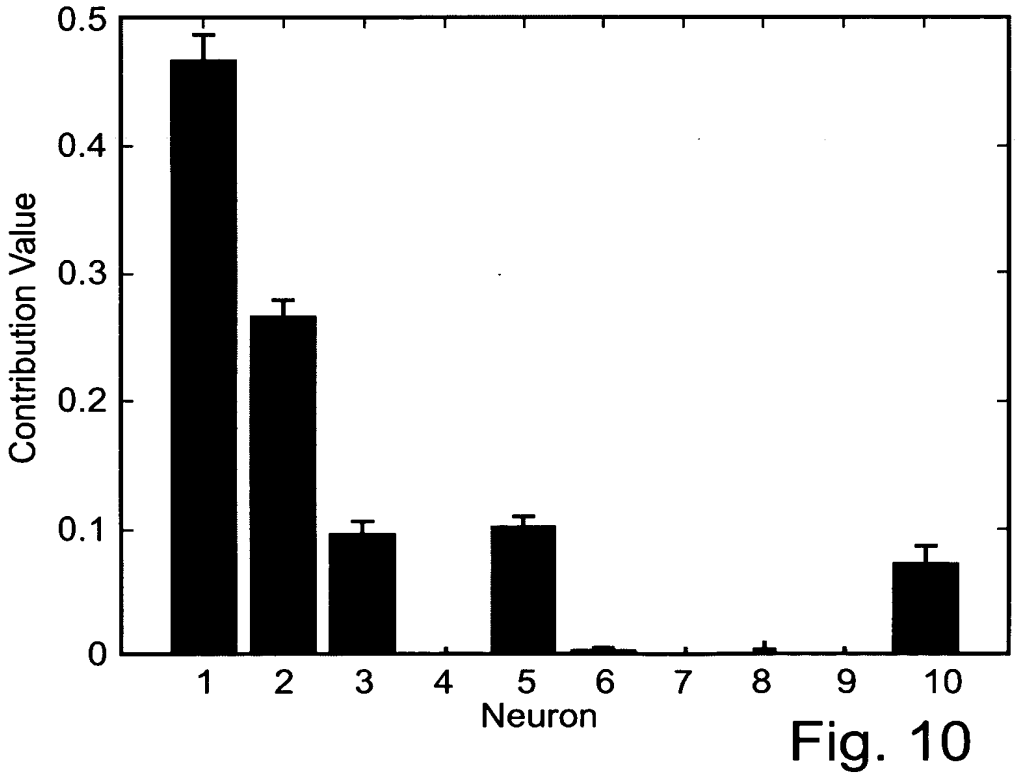
0.5
0.4
0.3
0.2
0.1
0
Contribution Value
1
2
3
4
5
6
7
8
9
10
Neuron

Fig. 10

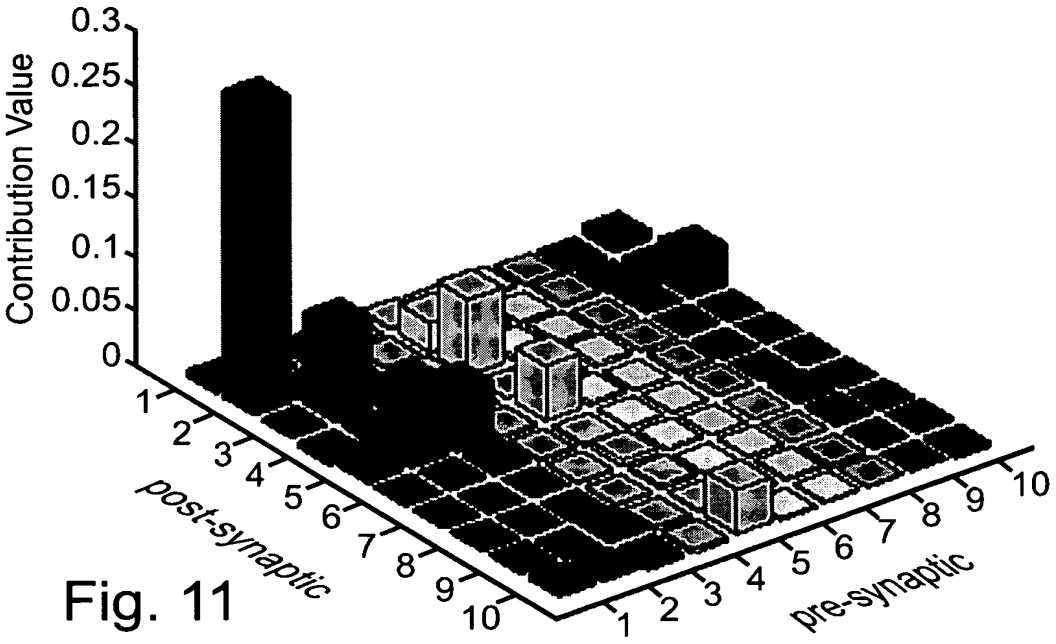
Contribution Value
0.3
0.25
0.2
0.15
0.1
0.05
0
post-synaptic
pre-synaptic
1
2
3
4
5
6
7
8
9
10

Fig. 11

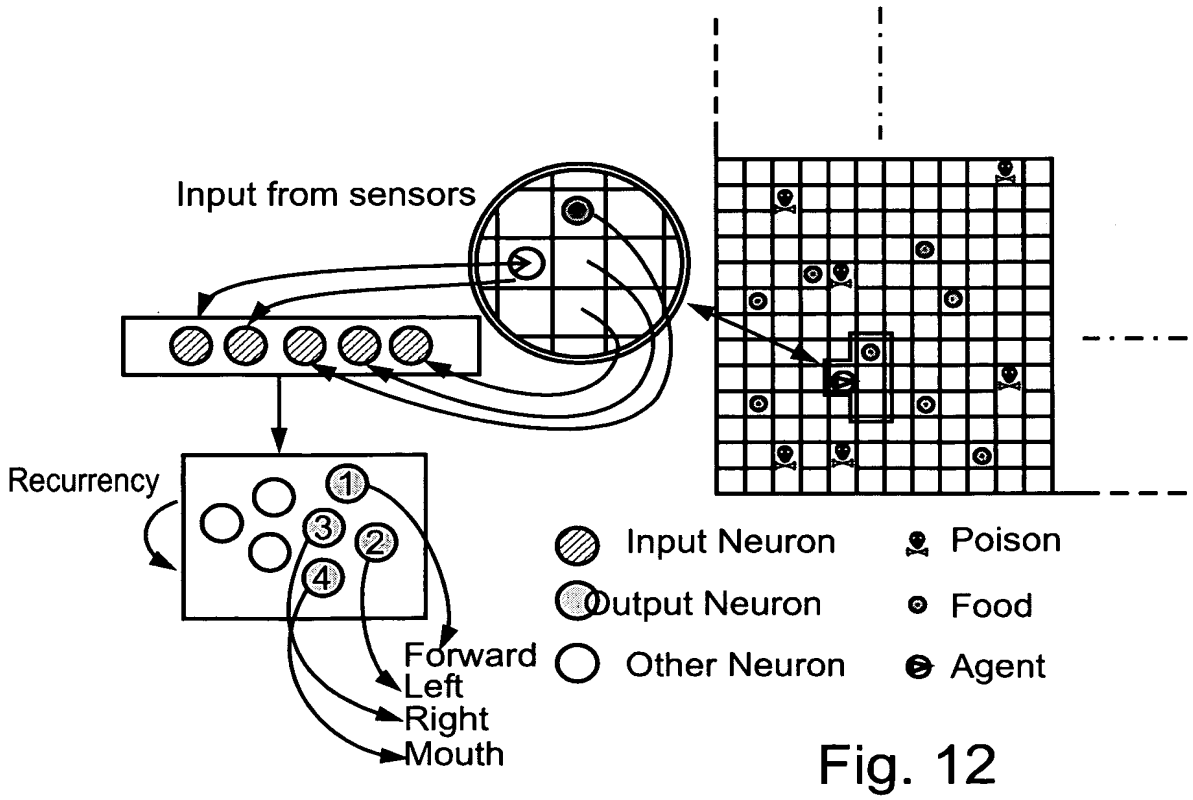
Input from sensors
Recurrency
1
2
3
4
Forward
Left
Right
Mouth
Input Neuron
Output Neuron
Other Neuron
Poison
Food
Agent

Fig. 12

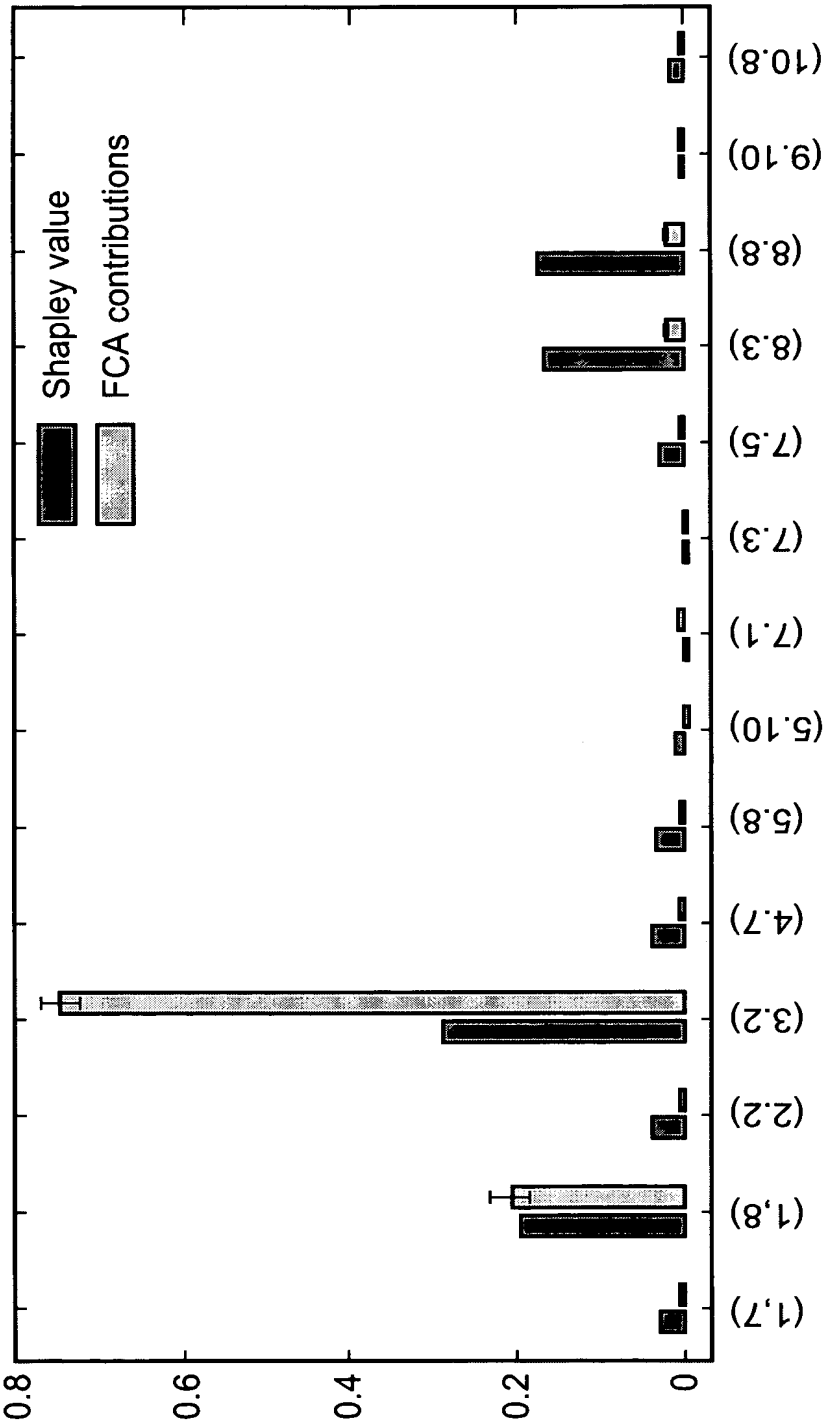
Shapley value
FCA contributions
0.8
0.6
0.4
0.2
0
(1,7)
(1,8)
(2,2)
(3,2)
(4,7)
(5,8)
(5,10)
(7,1)
(7,3)
(7,5)
(8,3)
(8,8)
(9,10)
(10,8)

Fig. 13

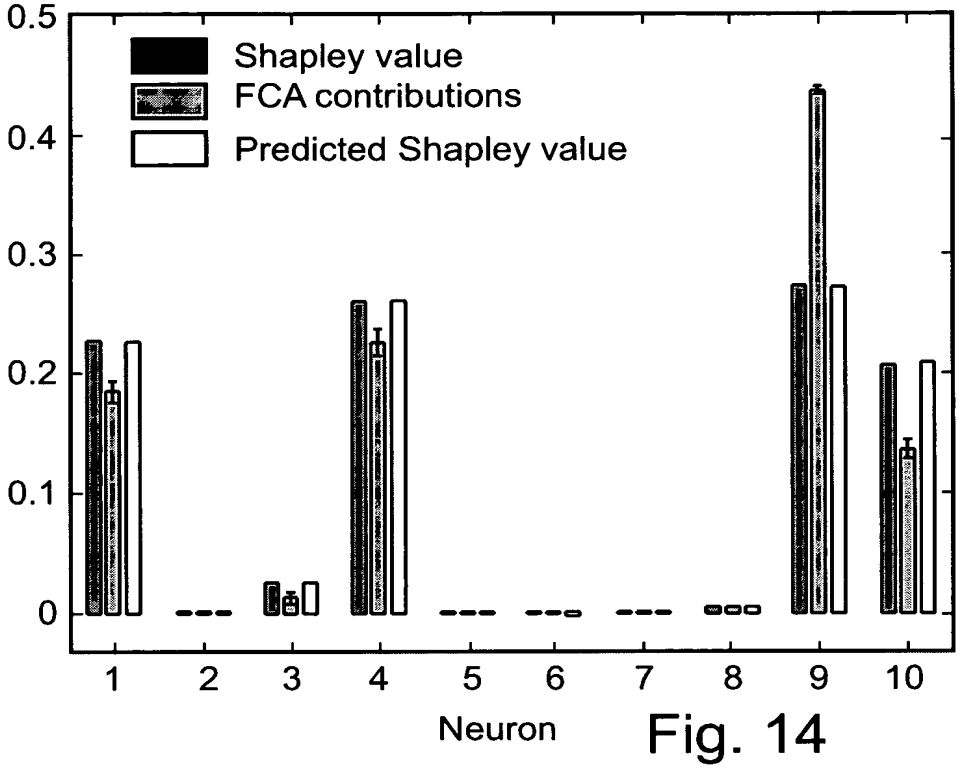
0.5
0.4
0.3
0.2
0.1
0
Shapley value
FCA contributions
Predicted Shapley value
1
2
3
4
5
6
7
8
9
10
Neuron

Fig. 14

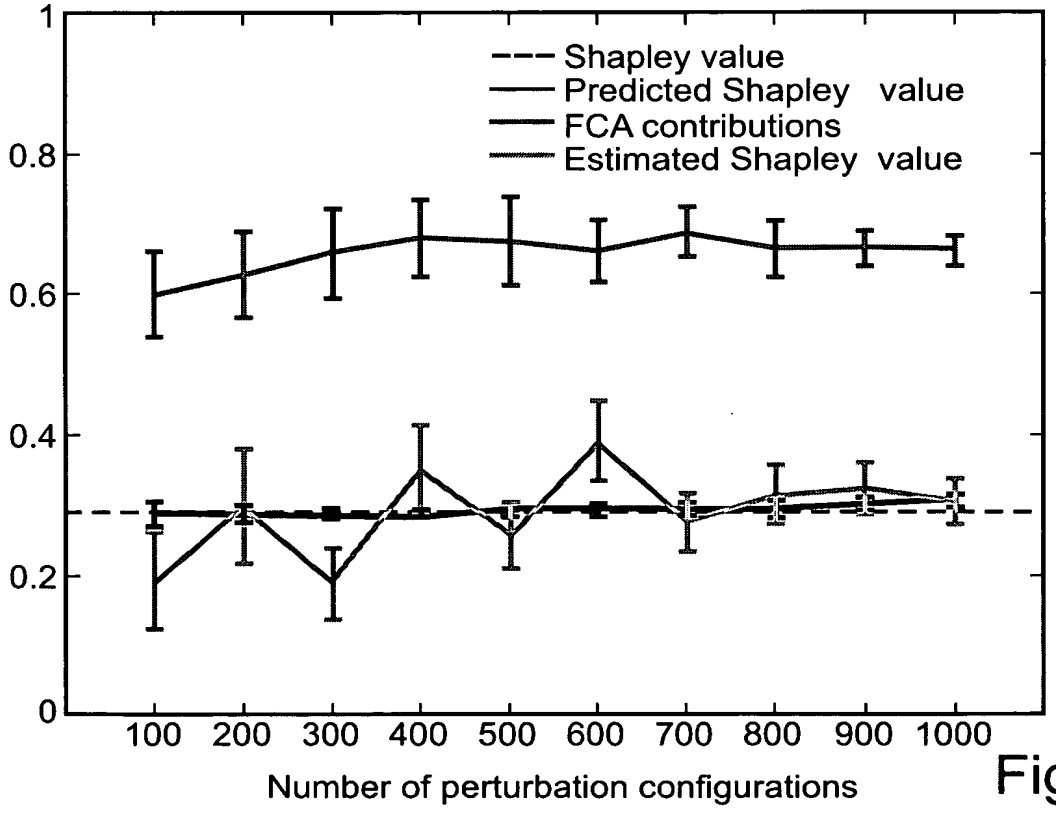
1
0.8
0.6
0.4
0.2
0
Shapley value
Predicted Shapley value
FCA contributions
Estimated Shapley value
100
200
300
400
500
600
700
800
900
1000
Number of perturbation configurations

Fig. 15

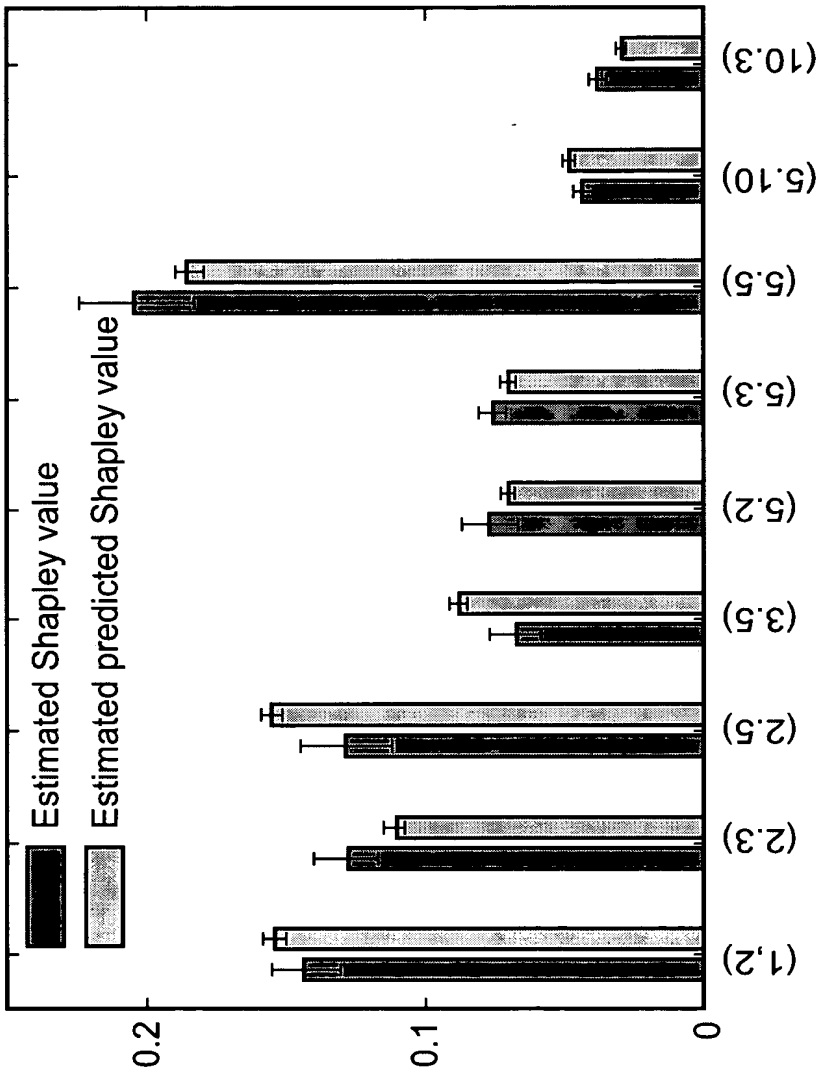
Estimated Shapley value
Estimated predicted Shapley value
0
0.1
0.2
(1,2)
(2,3)
(2,5)
(3,5)
(5,2)
(5,3)
(5,5)
(5,10)
(10,3)

Fig. 16

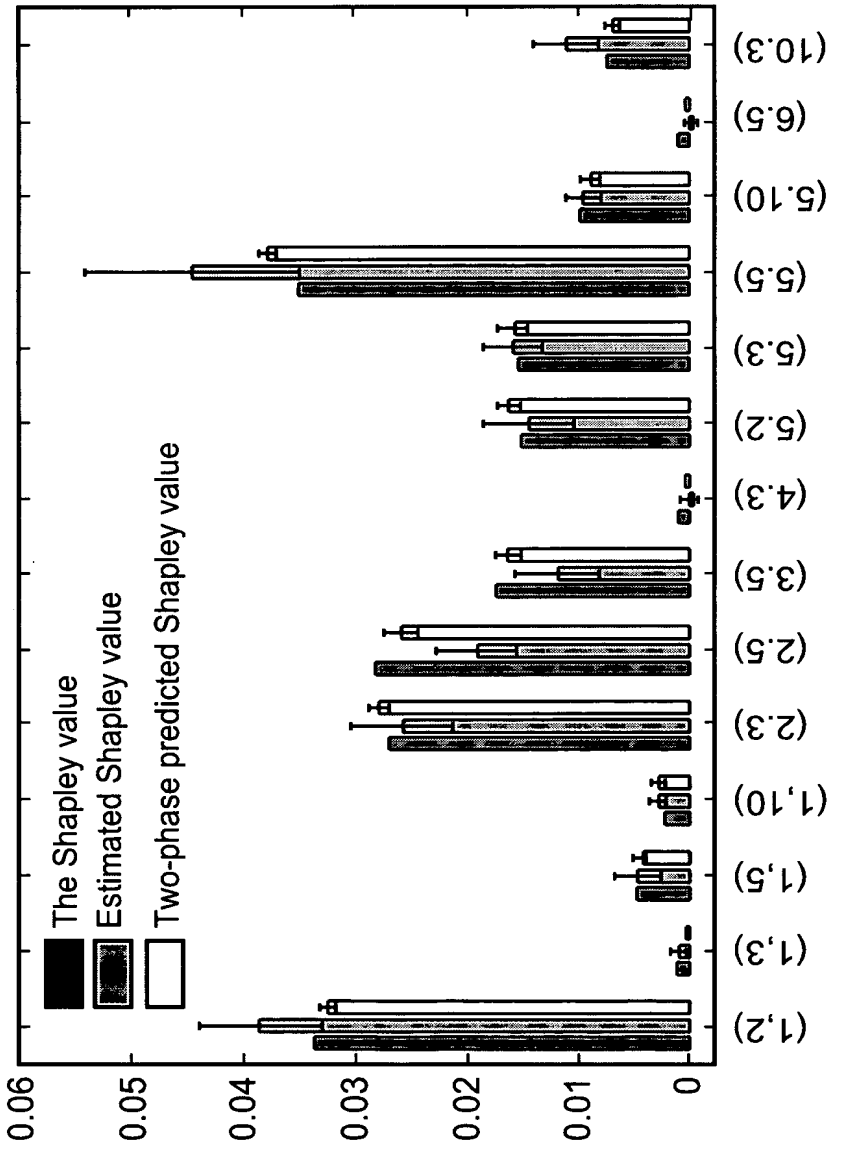
The Shapley value
Estimated Shapley value
Two-phase predicted Shapley value
0.06
0.05
0.04
0.03
0.02
0.01
0
(1,2)
(1,3)
(1,5)
(1,10)
(2,3)
(2,5)
(3,5)
(4,3)
(5,2)
(5,3)
(5,5)
(5,10)
(6,5)
(10,3)

Fig. 17

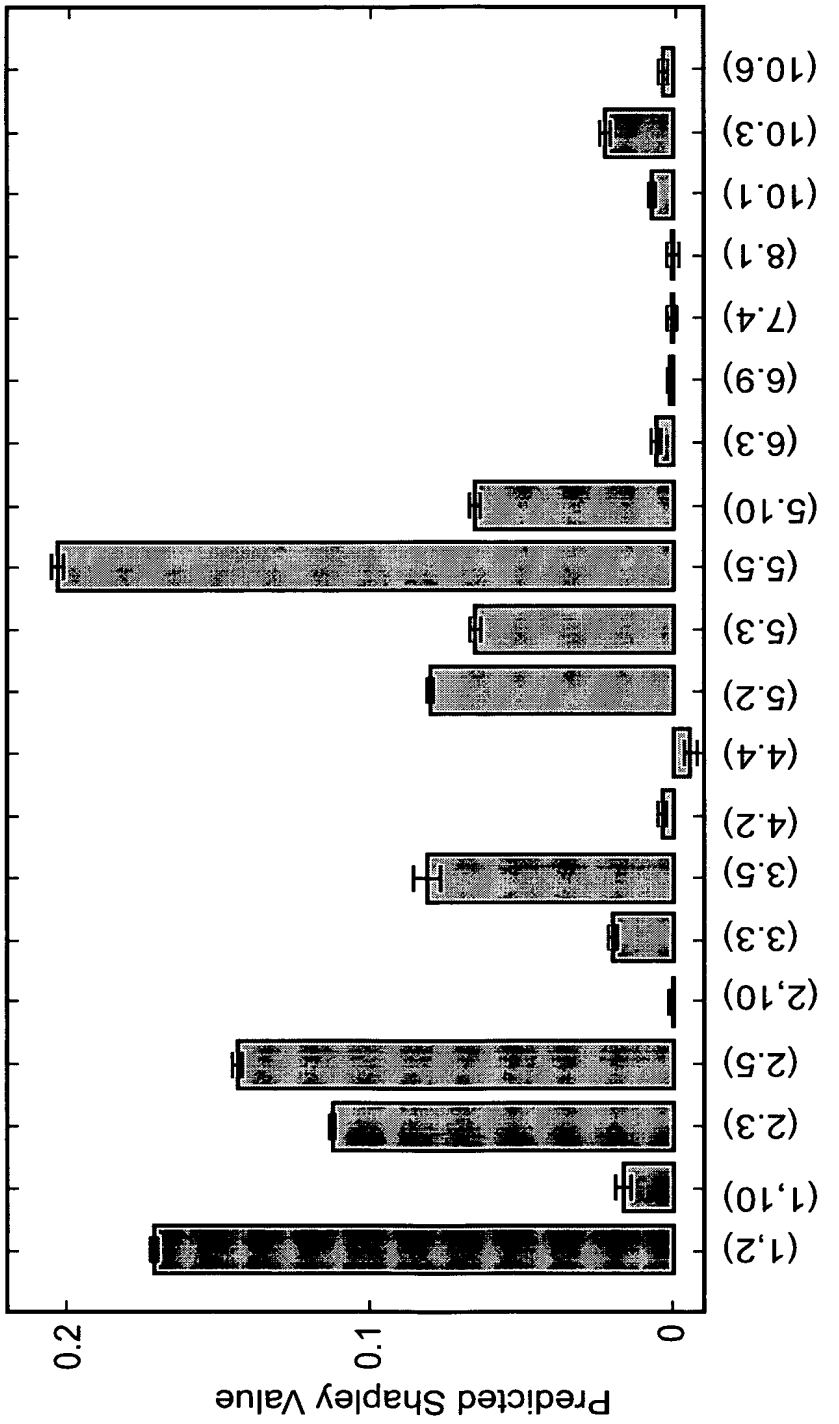
Predicted Shapley Value
0
0.1
0.2
(1,2)
(1,10)
(2,3)
(2,5)
(2,10)
(3,3)
(3,5)
(4,2)
(4,4)
(5,2)
(5,3)
(5,5)
(5,10)
(6,3)
(6,9)
(7,4)
(8,1)
(10,1)
(10,3)
(10,6)

Fig. 18

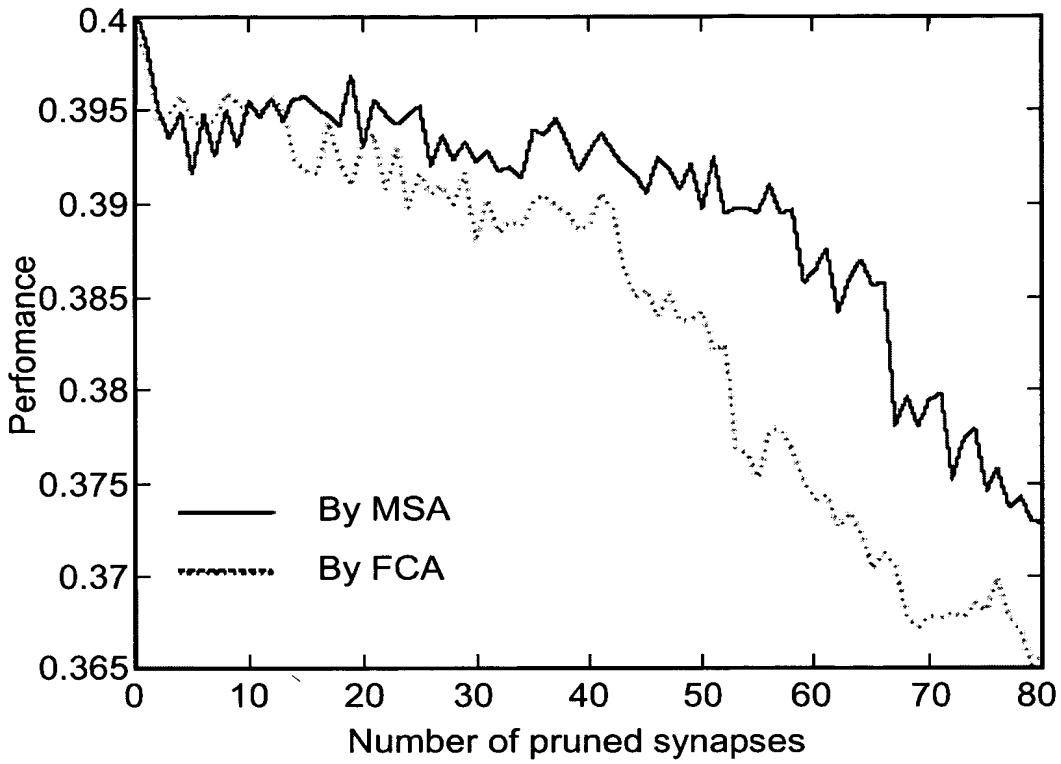
0.4
0.395
0.39
0.385
0.38
0.375
0.37
0.365
Perfomance
By MSA
By FCA
0
10
20
30
40
50
60
70
80
Number of pruned synapses

Fig. 19

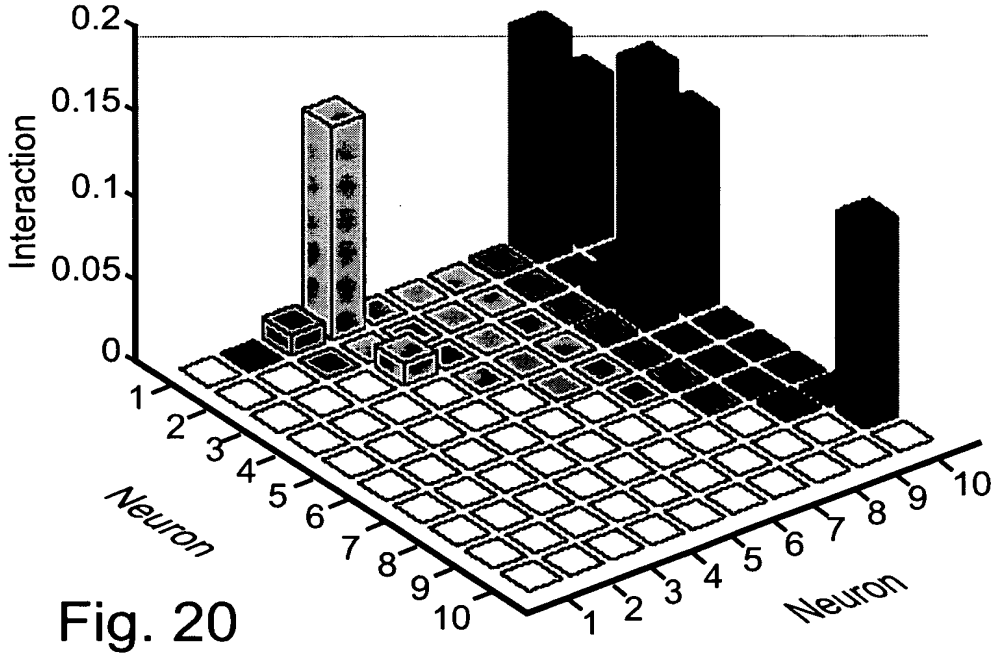
0.2
0.15
0.1
0.05
0
Interaction
1
2
3
4
5
6
7
8
9
10
Neuron
1
2
3
4
5
6
7
8
9
10
Neuron

Fig. 20

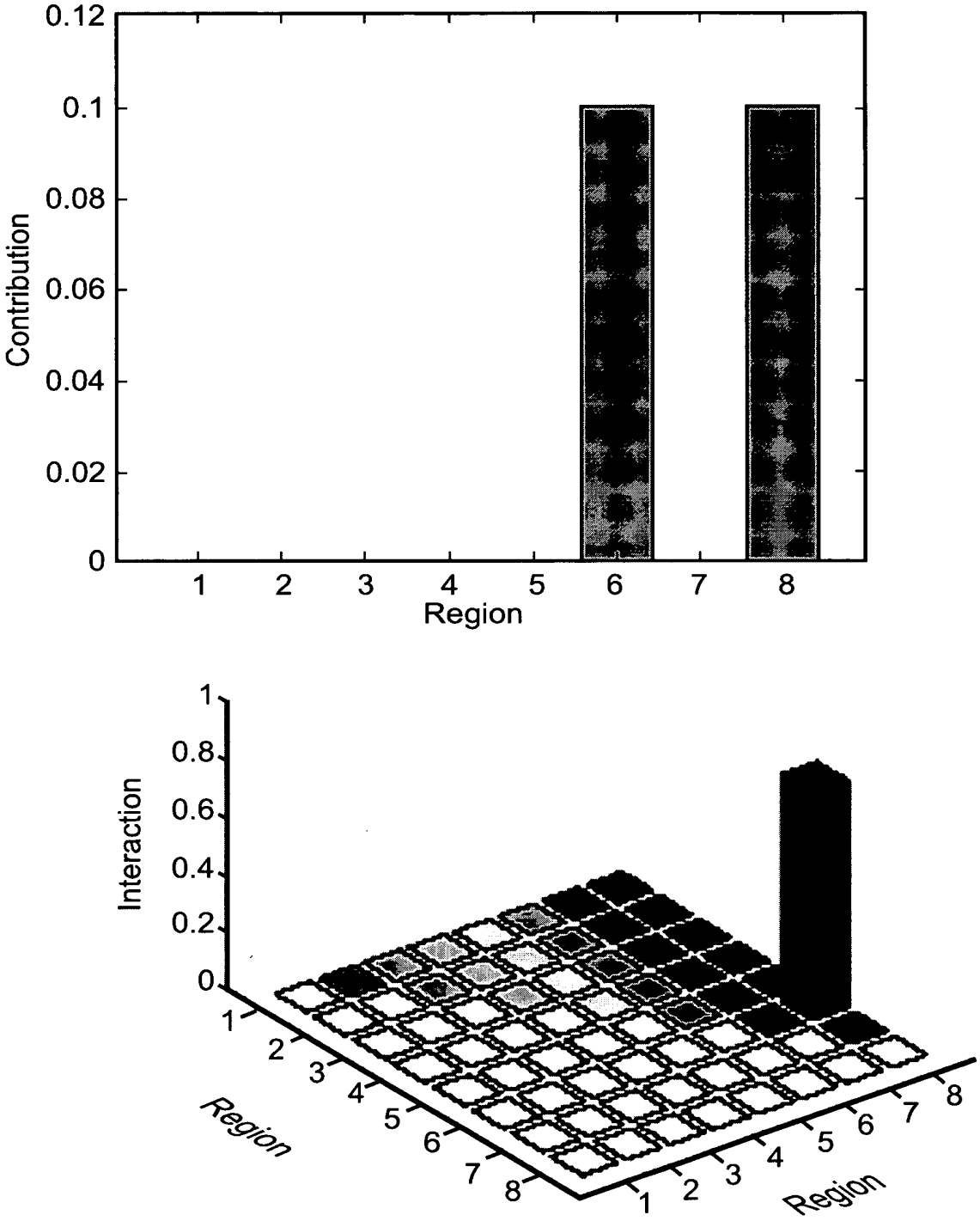
0.12
0.1
0.08
0.06
0.04
0.02
0
Contribution
1
2
3
4
5
6
7
8
Region
1
0.8
0.6
0.4
0.2
0
Interaction
Region
Region

Fig. 21

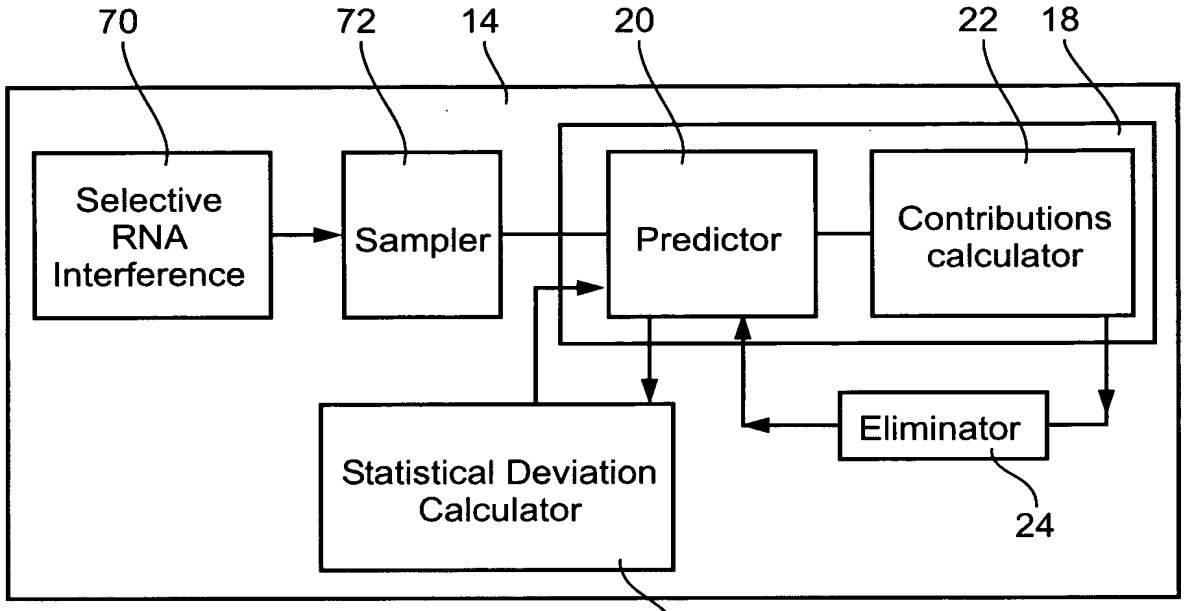
70
72
14
20
22
18
Selective RNA Interference
Sampler
Predictor
Contributions calculator
Eliminator
24
Statistical Deviation Calculator
26

Fig. 22

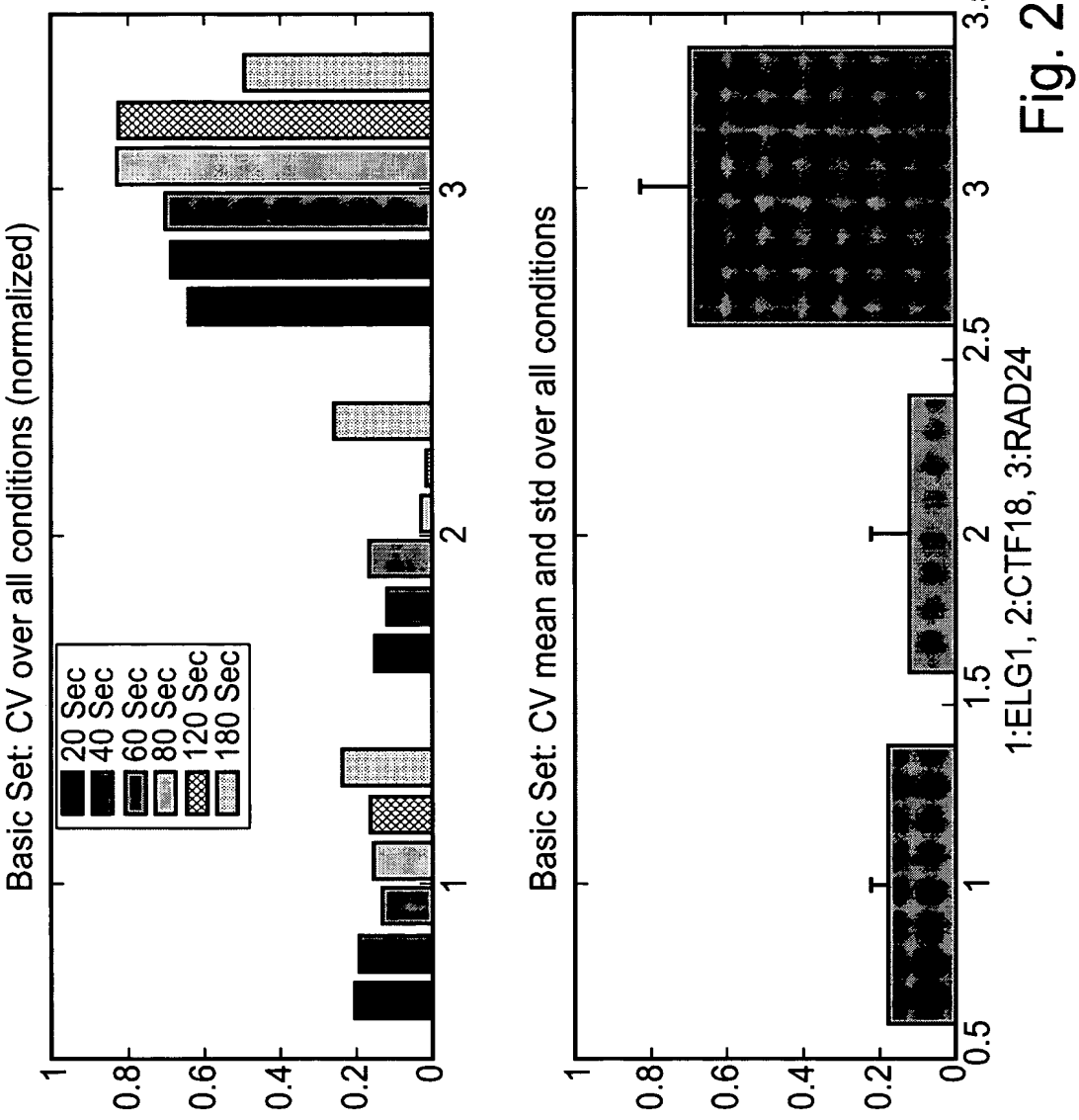
Basic Set: CV over all conditions (normalized)
20 Sec
40 Sec
60 Sec
80 Sec
120 Sec
180 Sec
Basic Set: CV mean and std over all conditions
1:ELG1, 2:CTF18, 3:RAD24

Fig. 23

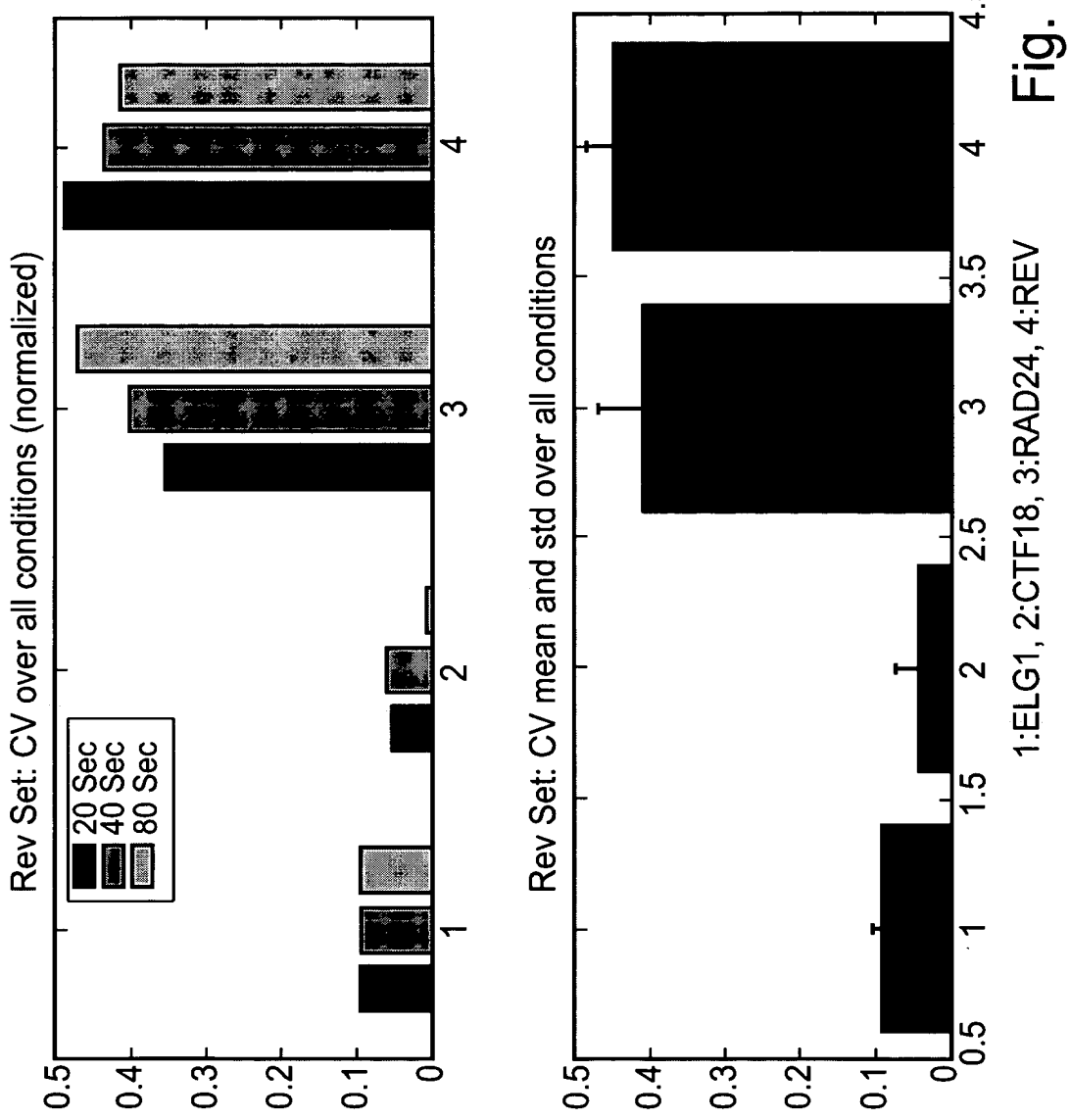
Rev Set: CV over all conditions (normalized)
20 Sec
40 Sec
80 Sec
0.5
0.4
0.3
0.2
0.1
0
1
2
3
4
Rev Set: CV mean and std over all conditions
0.5
0.4
0.3
0.2
0.1
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
1:ELG1, 2:CTF18, 3:RAD24, 4:REV

Fig. 24

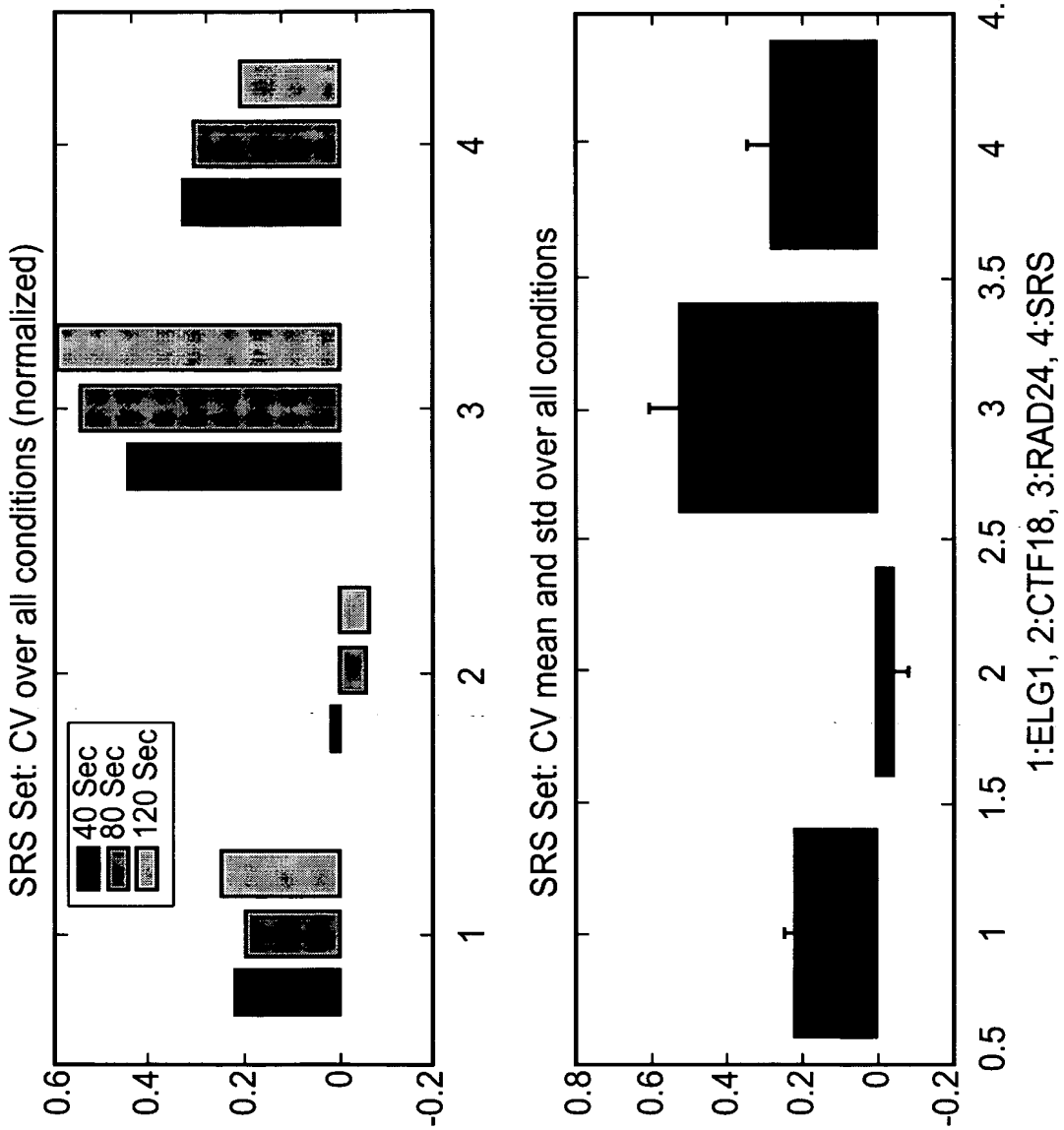
SRS Set: CV over all conditions (normalized)
40 Sec
80 Sec
120 Sec
0.6
0.4
0.2
0
-0.2
1
2
3
4
SRS Set: CV mean and std over all conditions
0.8
0.6
0.4
0.2
0
-0.2
0.5
1
1.5
2
2.5
3
3.5
4
4.5
1:ELG1, 2:CTF18, 3:RAD24, 4:SRS

Fig. 25

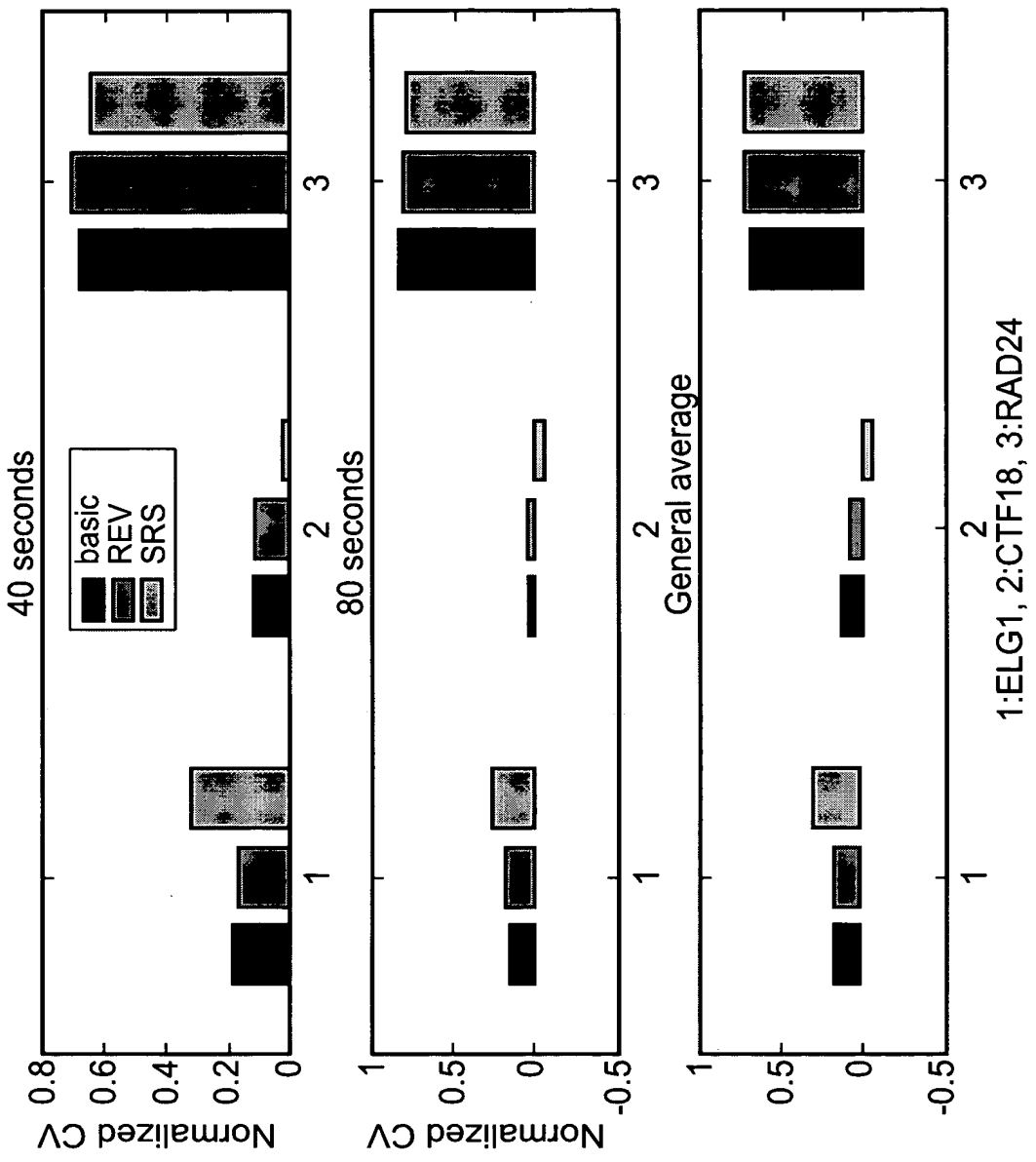
40 seconds
basic
REV
SRS
Normalized CV
0.8
0.6
0.4
0.2
0
1
2
3
80 seconds
Normalized CV
1
0.5
0
-0.5
General average
1:ELG1, 2:CTF18, 3:RAD24

Fig. 26

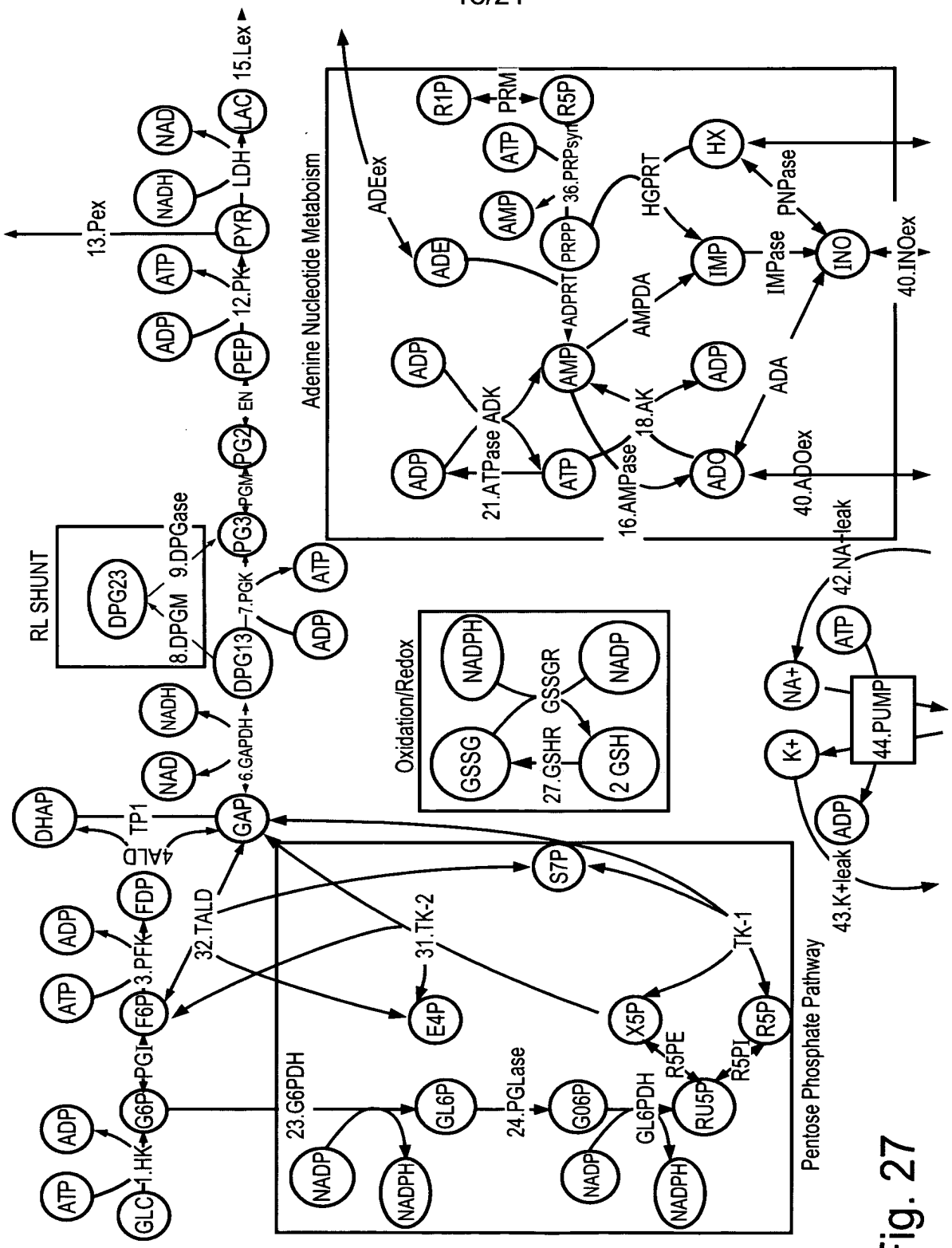
GLC
ATP
ADP
1.HK
G6P
PGI
F6P
ATP
ADP
3.PFK
FDP
4ALD
DHAP
TP1
GAP
NAD
NADH
6.GAPDH
DPG13
ADP
ATP
7.PGK
PG3
PGM
PG2
EN
PEP
ADP
ATP
12.PK
PYR
13.Pex
LDH
NADH
NAD
LAC
15.Lex
RL SHUNT
DPG23
8.DPGM
9.DPGase
32.TALD
31.TK-2
TK-1
S7P
E4P
X5P
R5P
R5PE
R5PI
RU5P
23.G6PDH
NADP
NADPH
GL6P
24.PGLase
G06P
GL6PDH
NADP
NADPH
Pentose Phosphate Pathway
Oxidation/Redox
GSSG
NADPH
27.GSHR
GSSGR
2 GSH
NADP
Adenine Nucleotide Metaboism
ADEex
ADE
ADPRT
PRPP
36.PRPSyn
R1P
PRM
R5P
ATP
AMP
HGPRT
HX
PNPase
IMP
IMPase
INO
40.INOex
AMPDA
ADP
ADK
AMP
18.AK
ADP
ADA
ADP
21.ATPase
ATP
16.AMPase
ADO
40.ADOex
42.NA+leak
NA+
ATP
K+
44.PUMP
ADP
43.K+leak

Fig. 27

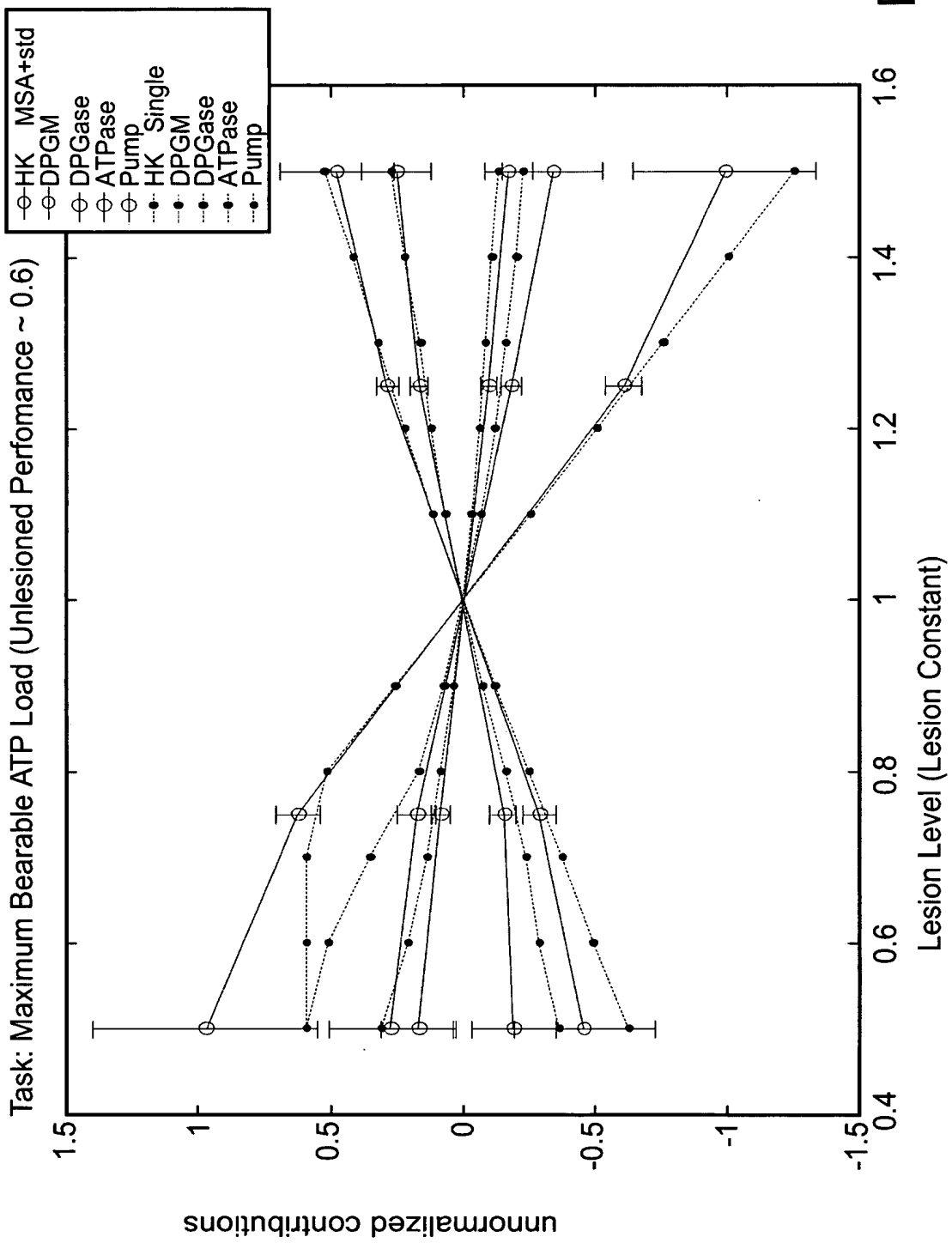
RBC is Additive
Task: Maximum Bearable ATP Load (Unlesioned Perfomance ~ 0.6)
HK MSA+std
DPGM
DPGase
ATPase
Pump
HK Single
DPGM
DPGase
ATPase
Pump
unnormalized contributions
Lesion Level (Lesion Constant)
1.5
1
0.5
0
-0.5
-1
-1.5
0.4
0.6
0.8
1
1.2
1.4
1.6

Fig. 28

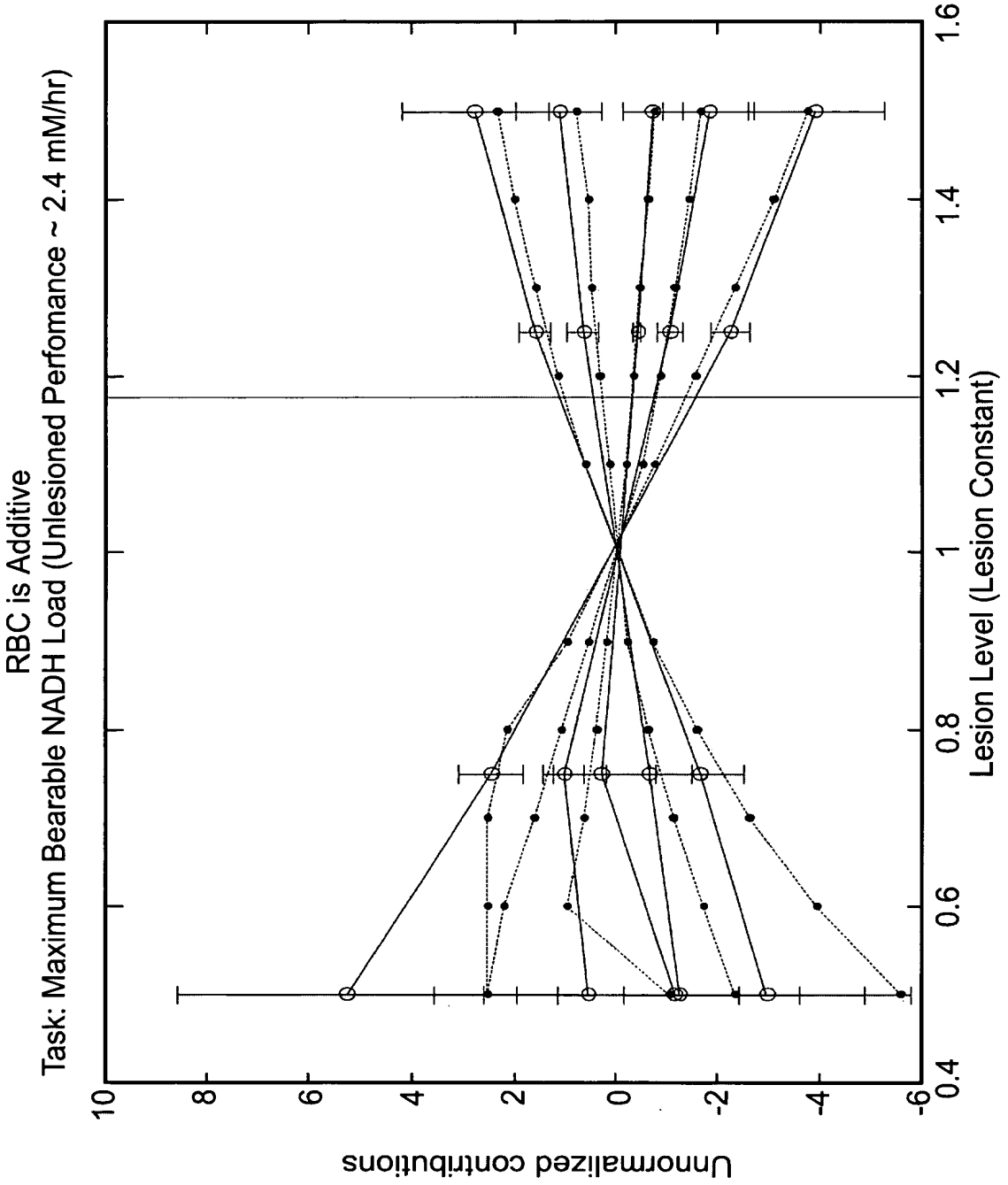
RBC is Additive
Task: Maximum Bearable NADH Load (Unlesioned Perfomance ~ 2.4 mM/hr)
Unnormalized contributions
10
8
6
4
2
0
-2
-4
-6
0.4
0.6
0.8
1
1.2
1.4
1.6
Lesion Level (Lesion Constant)

Fig. 29

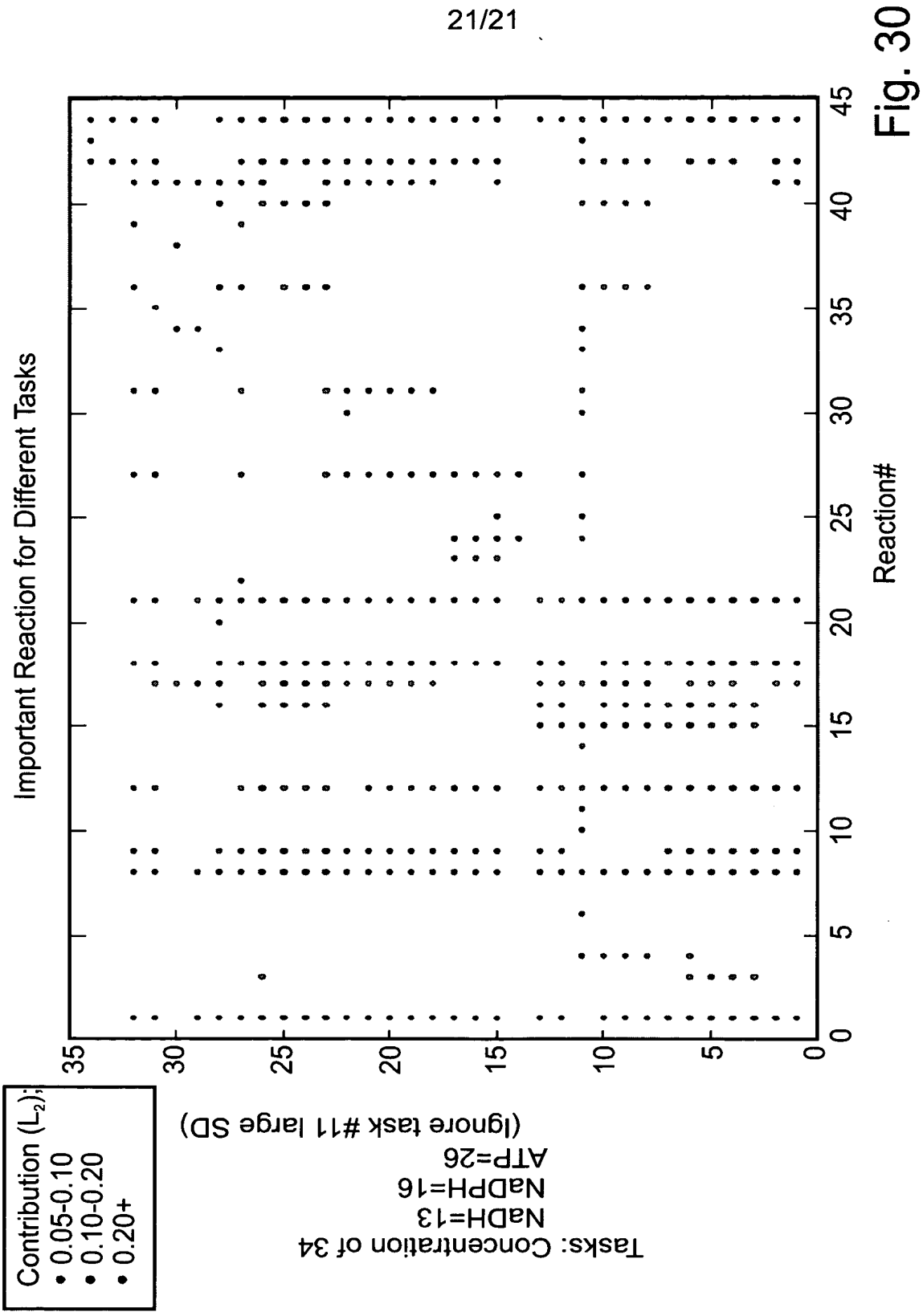
Important Reaction for Different Tasks
Contribution (L_2):
• 0.05-0.10
• 0.10-0.20
• 0.20+
Tasks: Concentration of 34
NaDH=13
NaDPH=16
ATP=26
(Ignore task #11 large SD)
Reaction#
0
5
10
15
20
25
30
35
40
45

Fig. 30